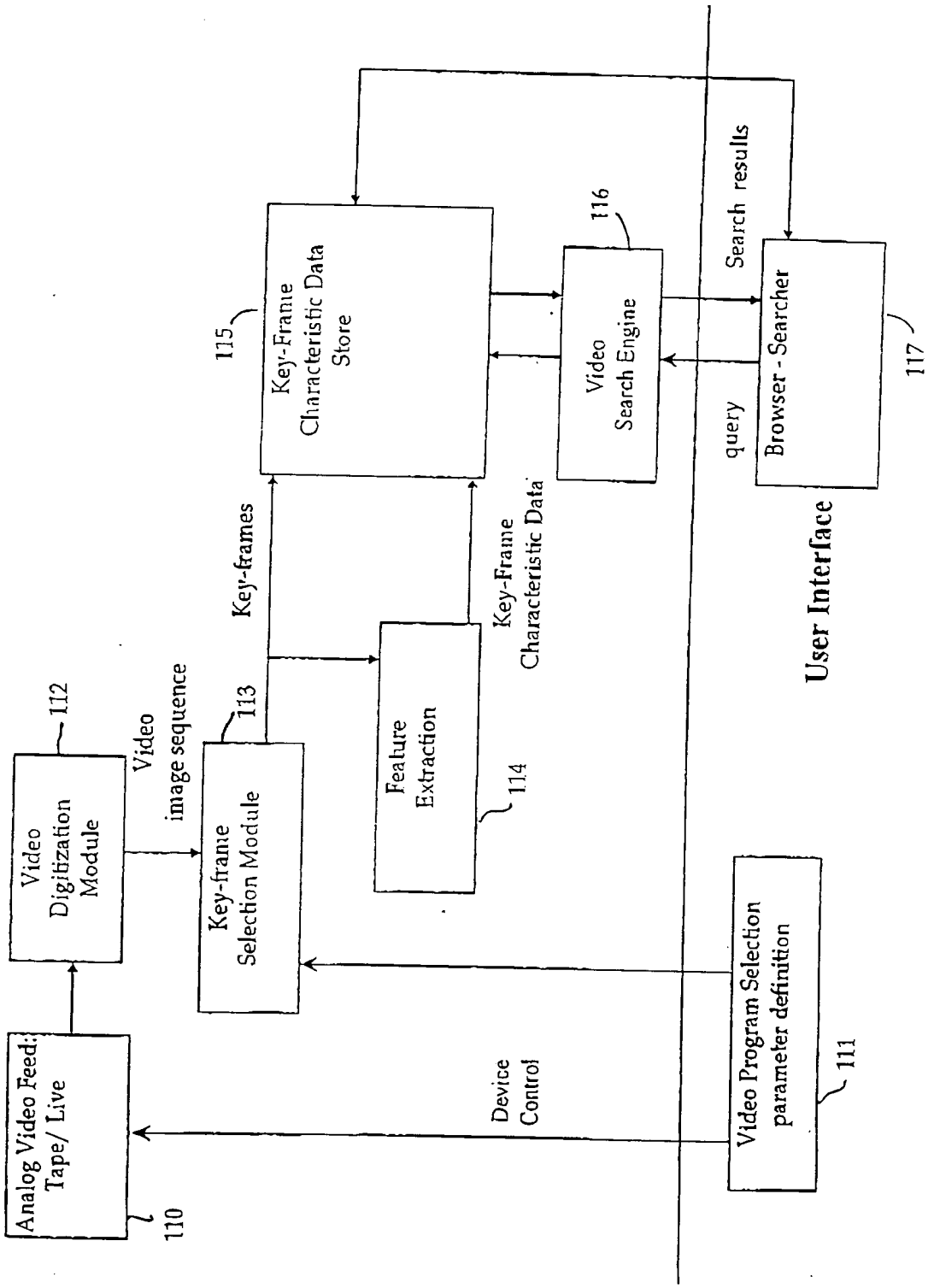

FIG 1A (prior art)

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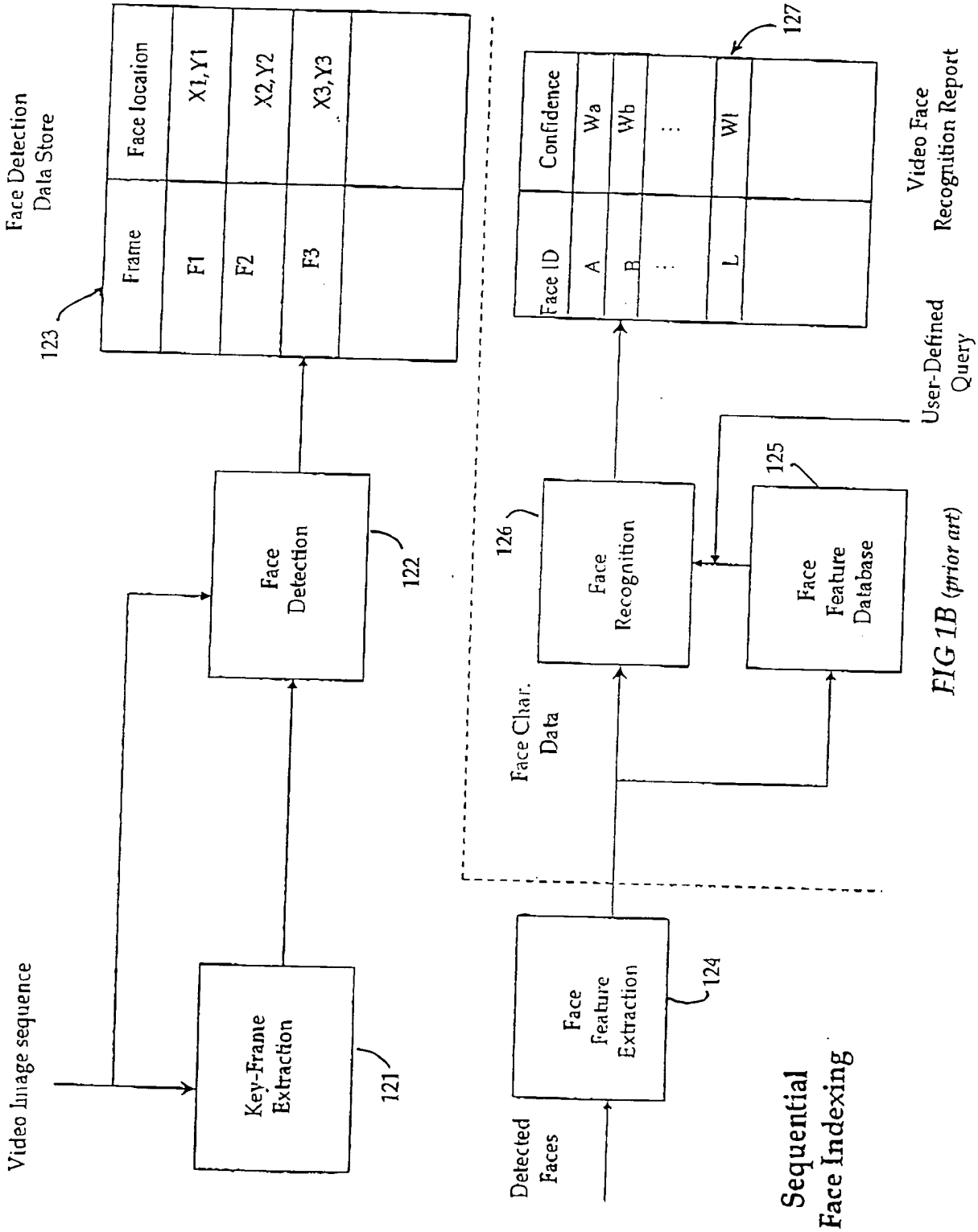


FIG 1B (prior art)

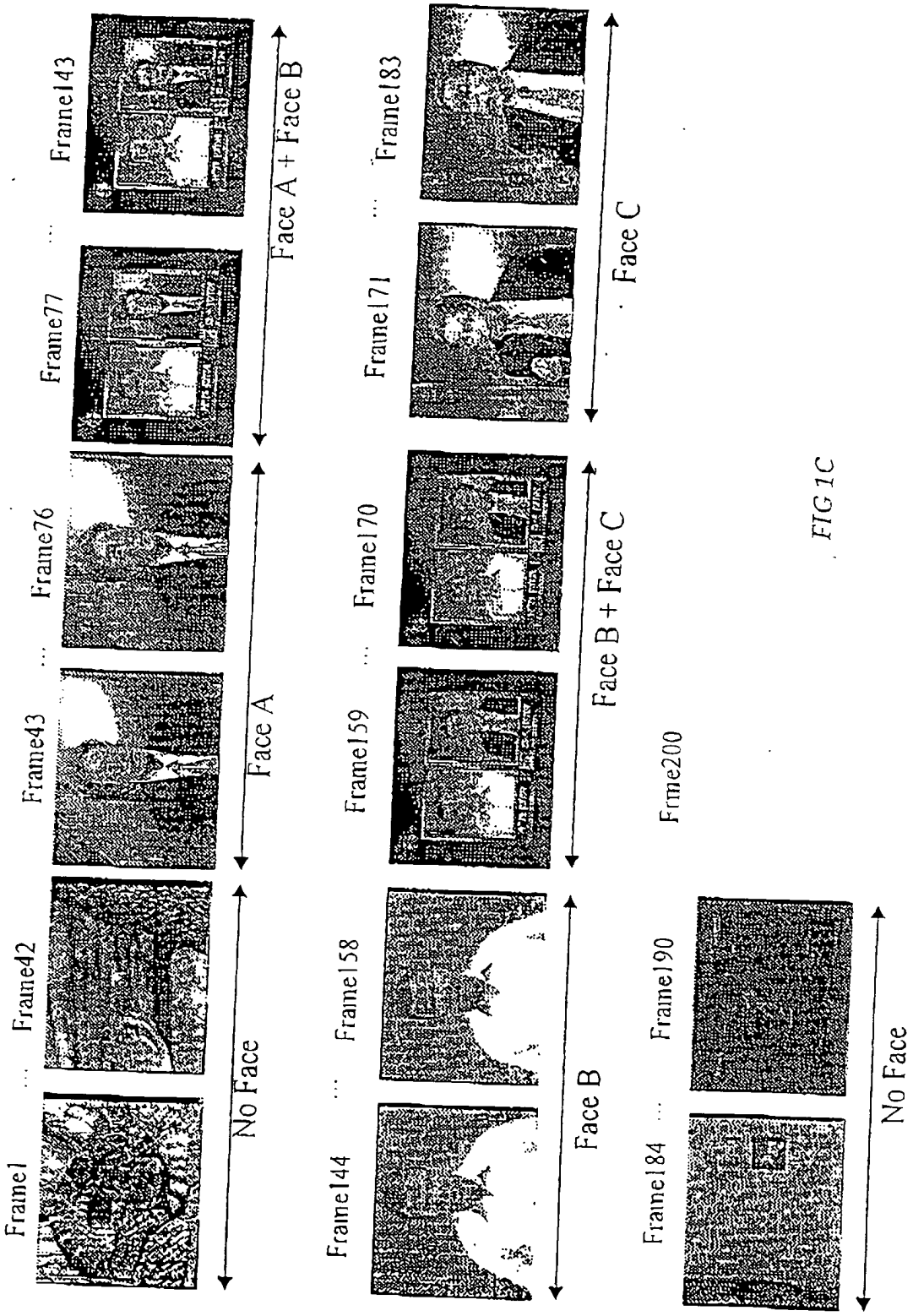

Frame1
Frame42
Frame43
Frame76
Frame77
Frame143
No Face
Face A
Face A + Face B
Frame144
Frame158
Frame159
Frame170
Frame171
Frame183
Face B
Face B + Face C
Face C
Frme200
Frame184
Frame190
No Face

FIG 1C

TO2290 "S9898760

Face Instance	Frame Index	Bounding Rectangle
I_1	Frame 43	R_1
...	...	...
I_33	Frame 76	R_k
I_34	Frame 77	R_k+1
I_35	Frame 77	...
I_36	Frame 78	R_n
...	..	R_n+1
I_198	Frame 143	R_s
...	...	...

FIG 1D (prior art)

WO 00/16243

09/786865
PCT/IL99/00487

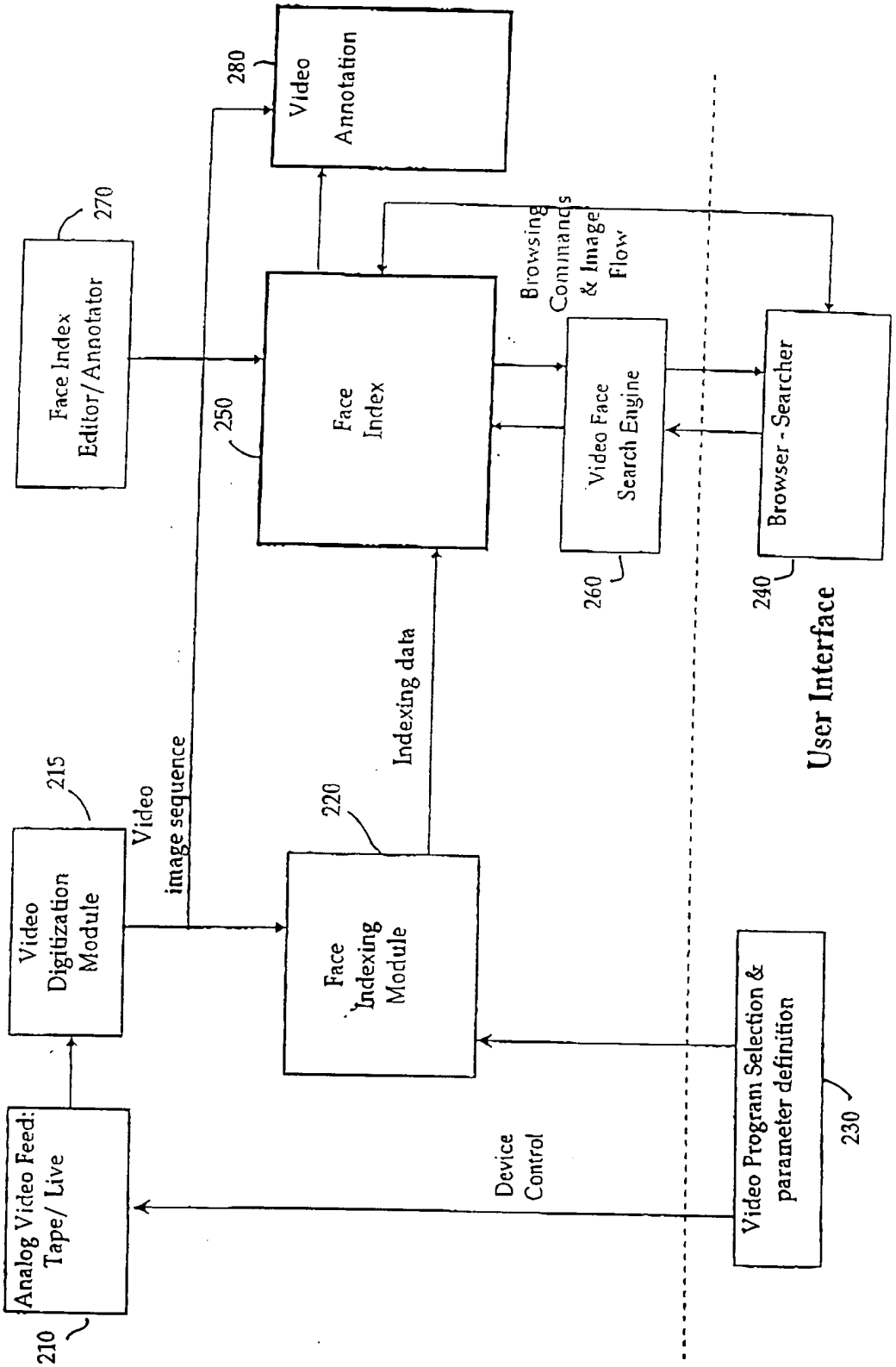
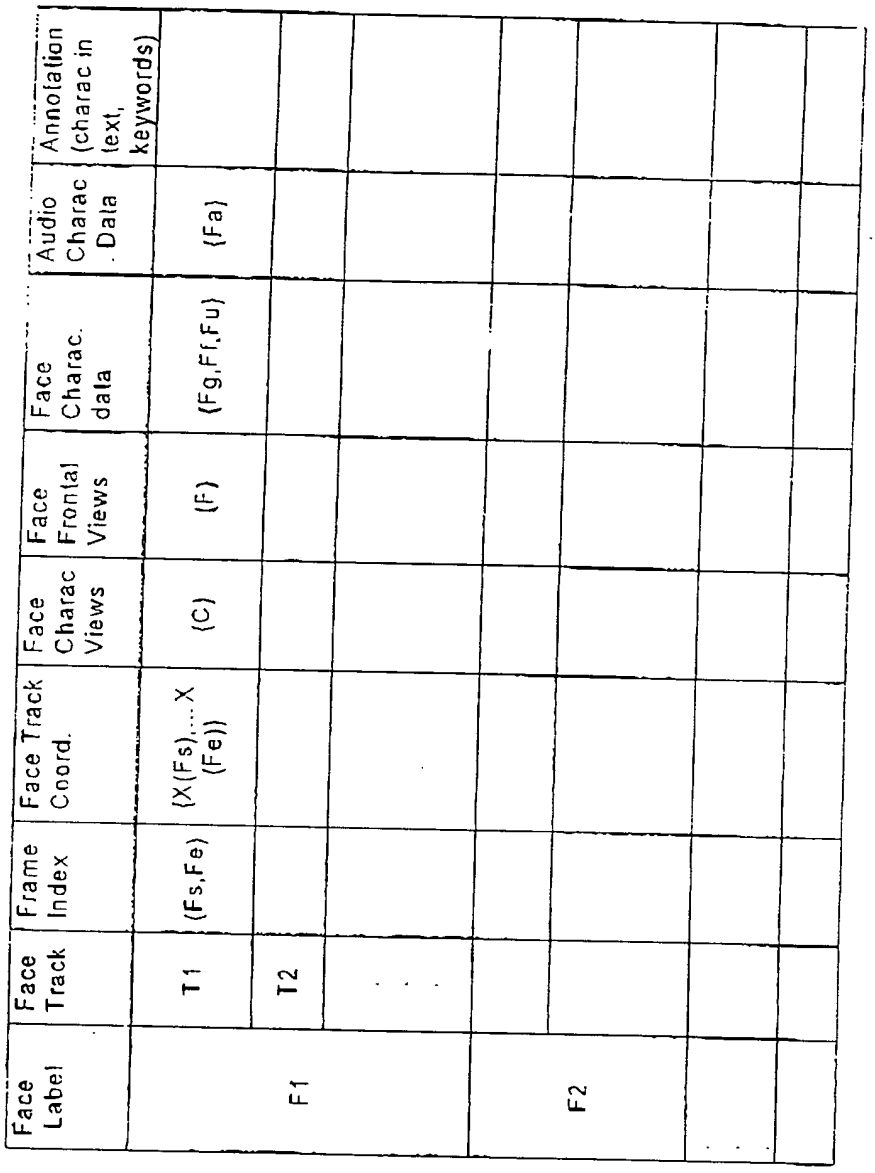

Analog Video Feed: Tape/ Live
210
Video Digitization Module
215
Video image sequence
Face Indexing Module
220
Indexing data
Face Index
250
Face Index Editor/Annotator
270
Video Annotation
280
Video Face Search Engine
260
Browser - Searcher
240
Browsing Commands & Image Flow
Device Control
Video Program Selection & parameter definition
230
User Interface

FIG 2



Face Label	Face Track	Frame Index	Face Track Coord.	Face Charac Views	Face Frontal Views	Face Charac. data	Audio Charac. Data	Annotation (charac in text, keywords)
F1	T1	(Fs,Fe)	(X(Fs),...X(Fe))	(C)	(F)	(Fg,Ff,Fu)	(Fa)	
	T2							
	. . .							
F2								
. . .								

FIG 3

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Start Frame Fs
End Frame Fe
Face Track Coordinates $\bar{X}_{F_s}, \ldots, \bar{X}_{F_e}$
Face_Characteristic_Views Face_Frontal_Views
Face_Characteristic_Data
Audio_Characteristic_Data

Face Track Structure

FIG 4

T07290 "S9899760

Face Label	Face Track	Frame Index	Bounding Rectangle	...	Annotation
A	A1	43 - 76	Per face		Bob
	A2	77-143	...		Bob
B	B1	77-143	R_k		Bill; Opposition leader candidate
	B2	144-158	R_k+1		Bill; Opposition leader candidate
	B3	159-170	...		Bill; Opposition leader candidate
C	C1	159-170	R_n		Smith; Labor party candidate
	C2	171-183	...		Smith; Labor party candidate

FIG 5

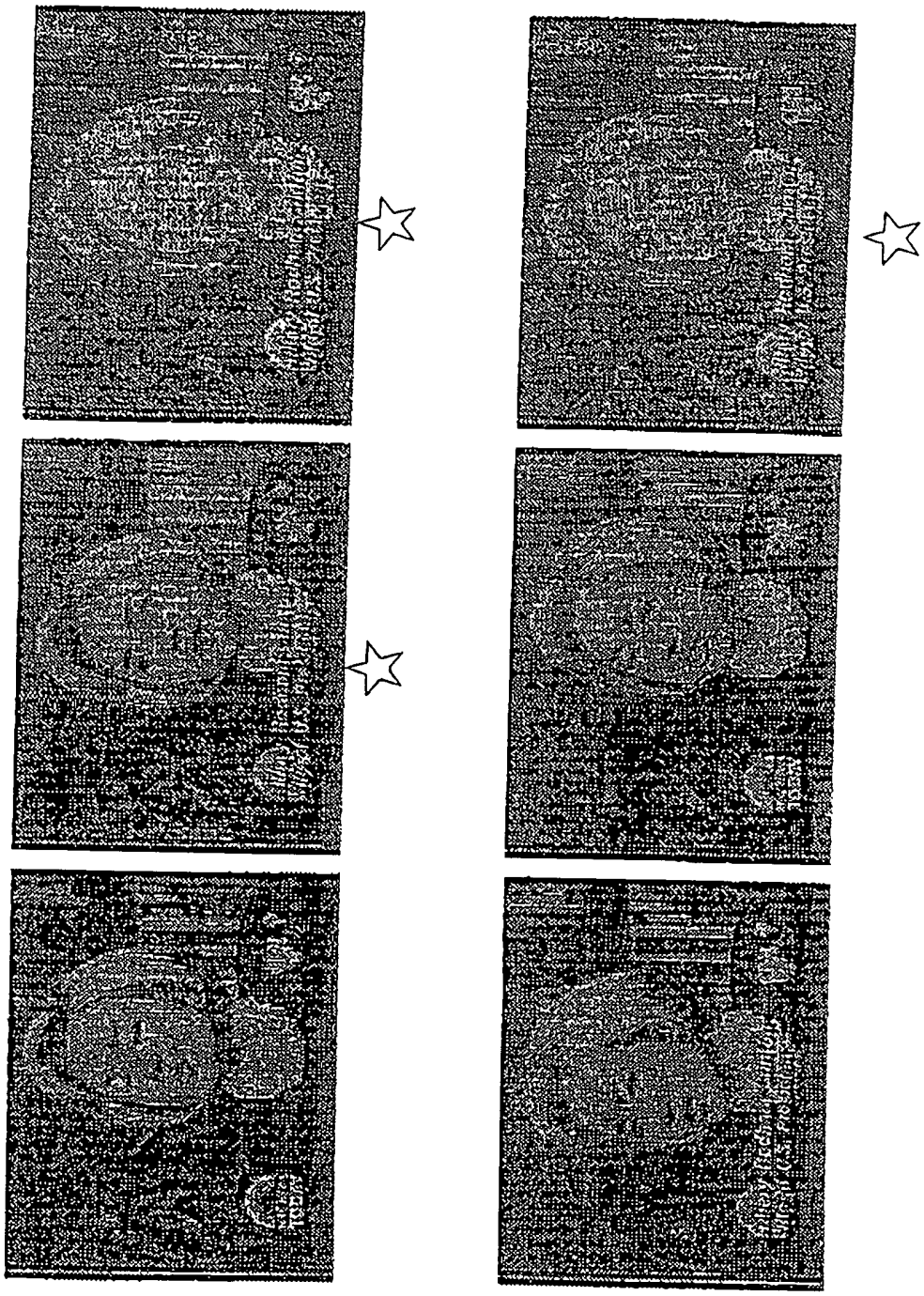


FIG 6

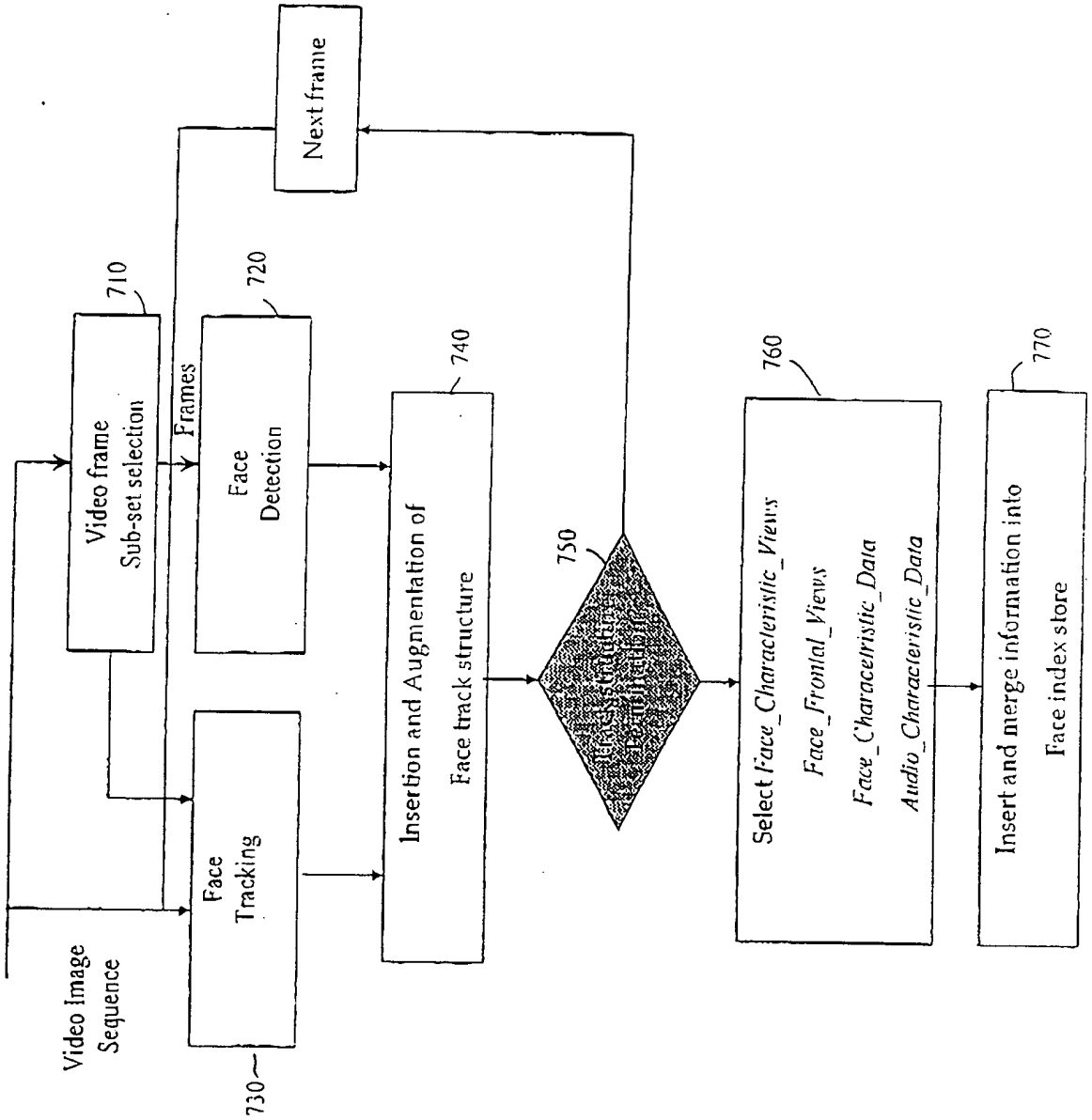

Next frame
Video frame Sub-set selection
710
Frames
Face Detection
720
Face Tracking
730
Video Image Sequence
Insertion and Augmentation of Face track structure
740
750
Select Face_Characteristic_Views
Face_Frontal_Views
Face_Characteristic_Data
Audio_Characteristic_Data
760
Insert and merge information into Face index store
770

FIG 7

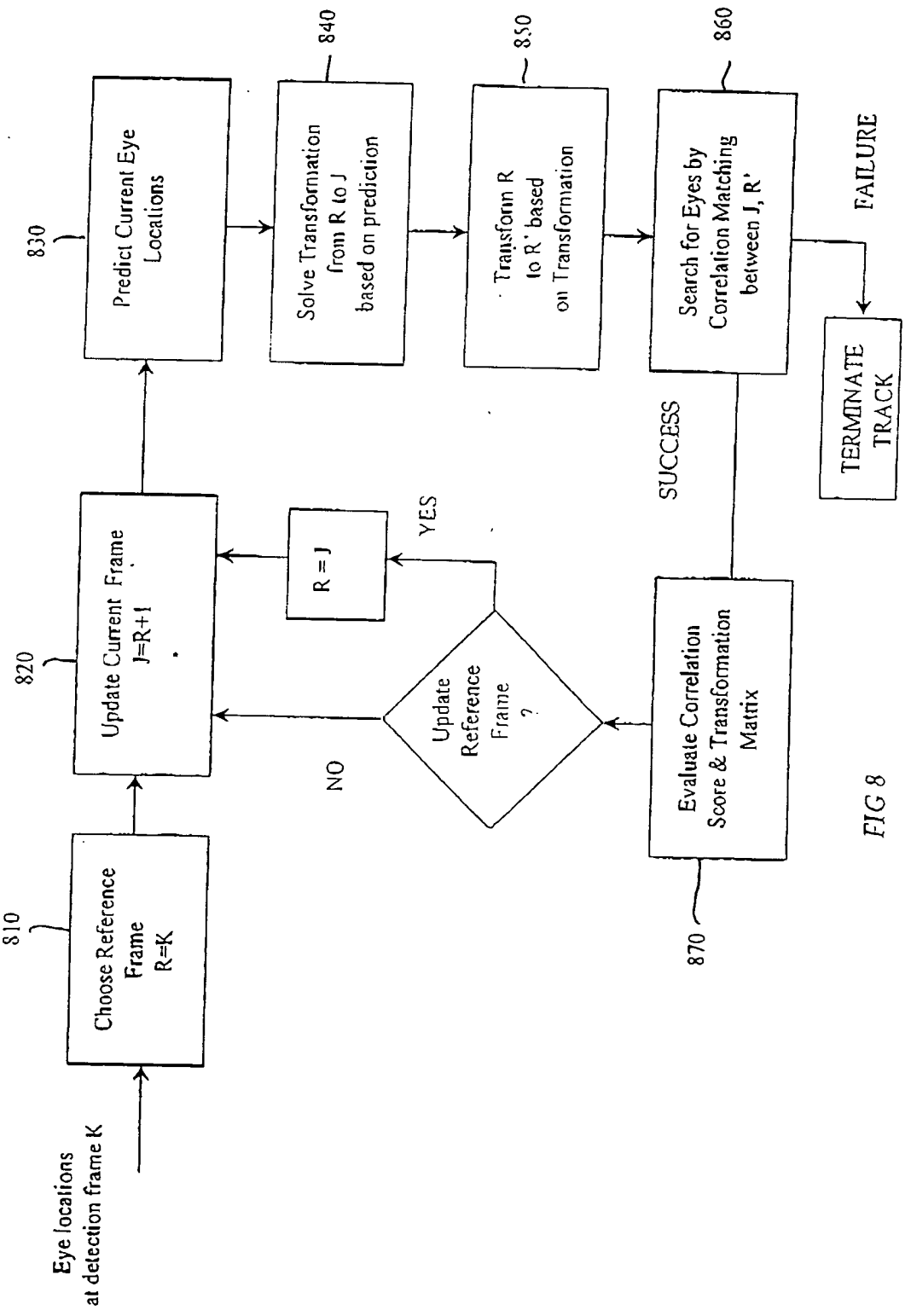

Eye locations at detection frame K
Choose Reference Frame R=K
810
Update Current Frame J=R+1
820
Predict Current Eye Locations
830
Solve Transformation from R to J based on prediction
840
Transform R to R' based on Transformation
850
Search for Eyes by Correlation Matching between J, R'
860
FAILURE
TERMINATE TRACK
SUCCESS
Evaluate Correlation Score & Transformation Matrix
870
Update Reference Frame ?
YES
NO
R = J

FIG 8

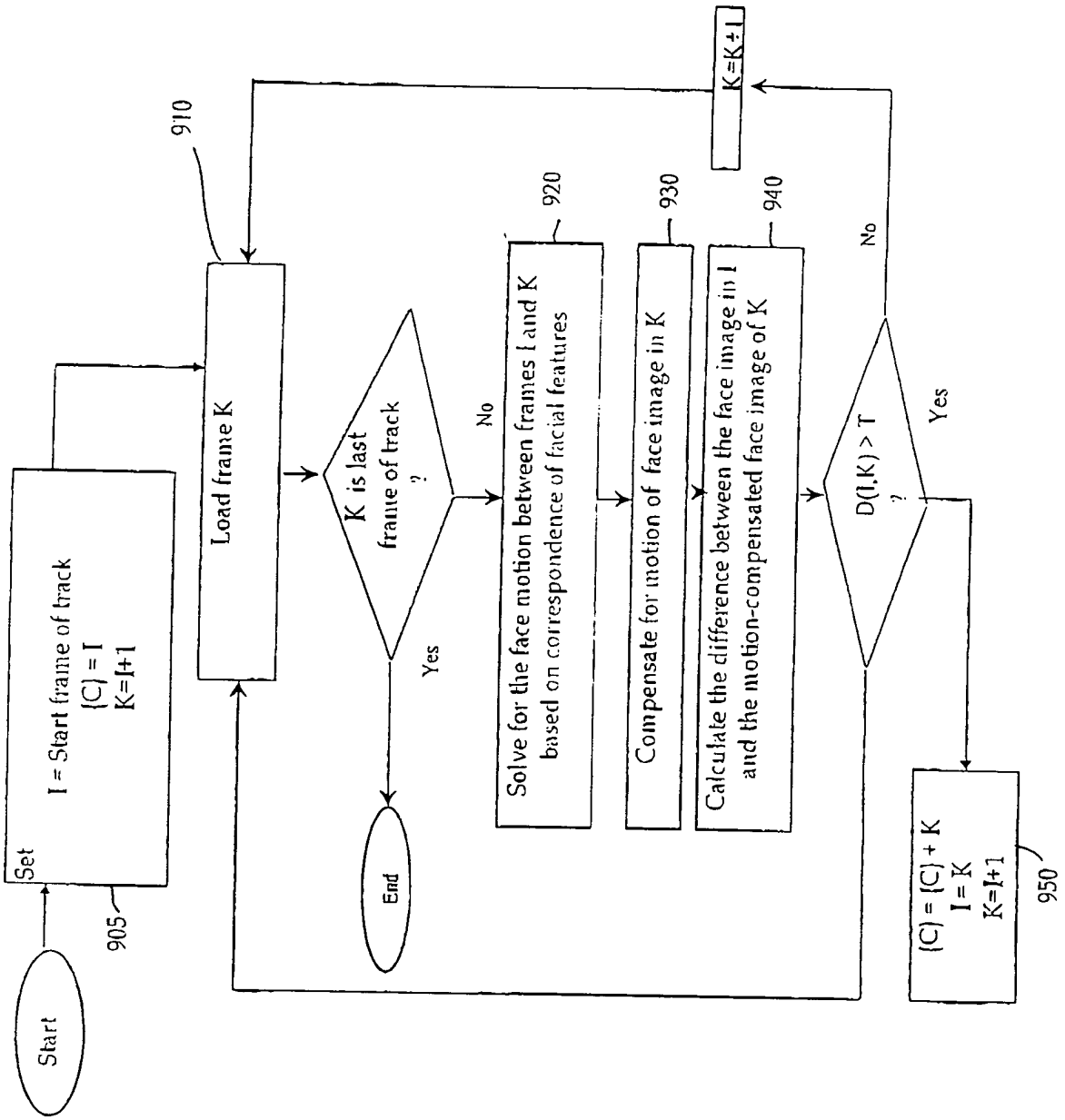

Start
Set
I = Start frame of track
{C} = I
K=I+1
905
Load frame K
910
K is last frame of track ?
No
Yes
End
Solve for the face motion between frames I and K based on correspondence of facial features
920
Compensate for motion of face image in K
930
Calculate the difference between the face image in I and the motion-compensated face image of K
940
D(I,K) > T ?
Yes
No
{C} = {C} + K
I = K
K=I+1
950
K=K+1

FIG 9

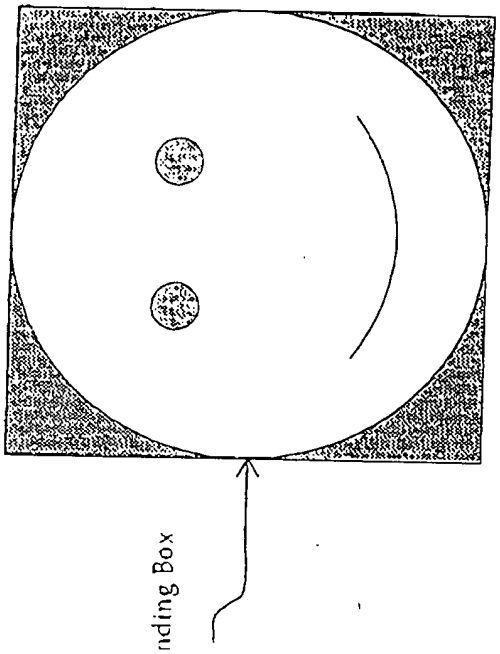


Figure 10a

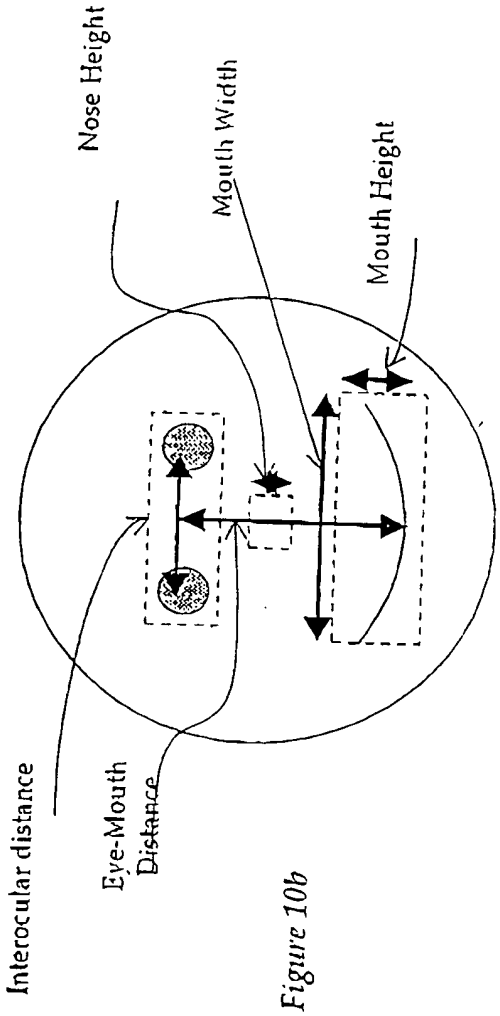
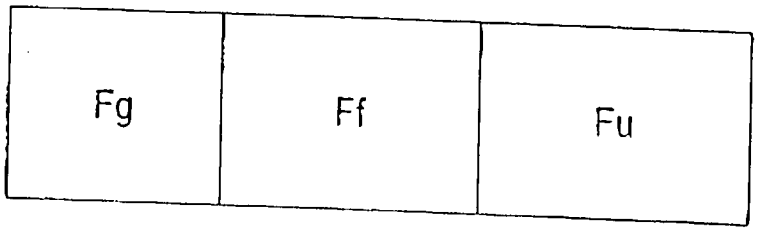


Figure 10b

TO2290 S9899260



Fg:

Face Templates

Feature Templates

F1	F2			Left eye	Right eye	nose
				mouth	chin	

Ff: Geometrical Features

Interocular distance (between eye distance)	Vertical projection: Eye-nose	Vertical projection: Eye-mouth	Chin width	

Fu: Unique Features

eyeglasses		bold		Hair color		
Yes/no	Conf.	Yes/no	Conf.	(black,brown, orange ,yellow,...)	Conf.	

FIG 11

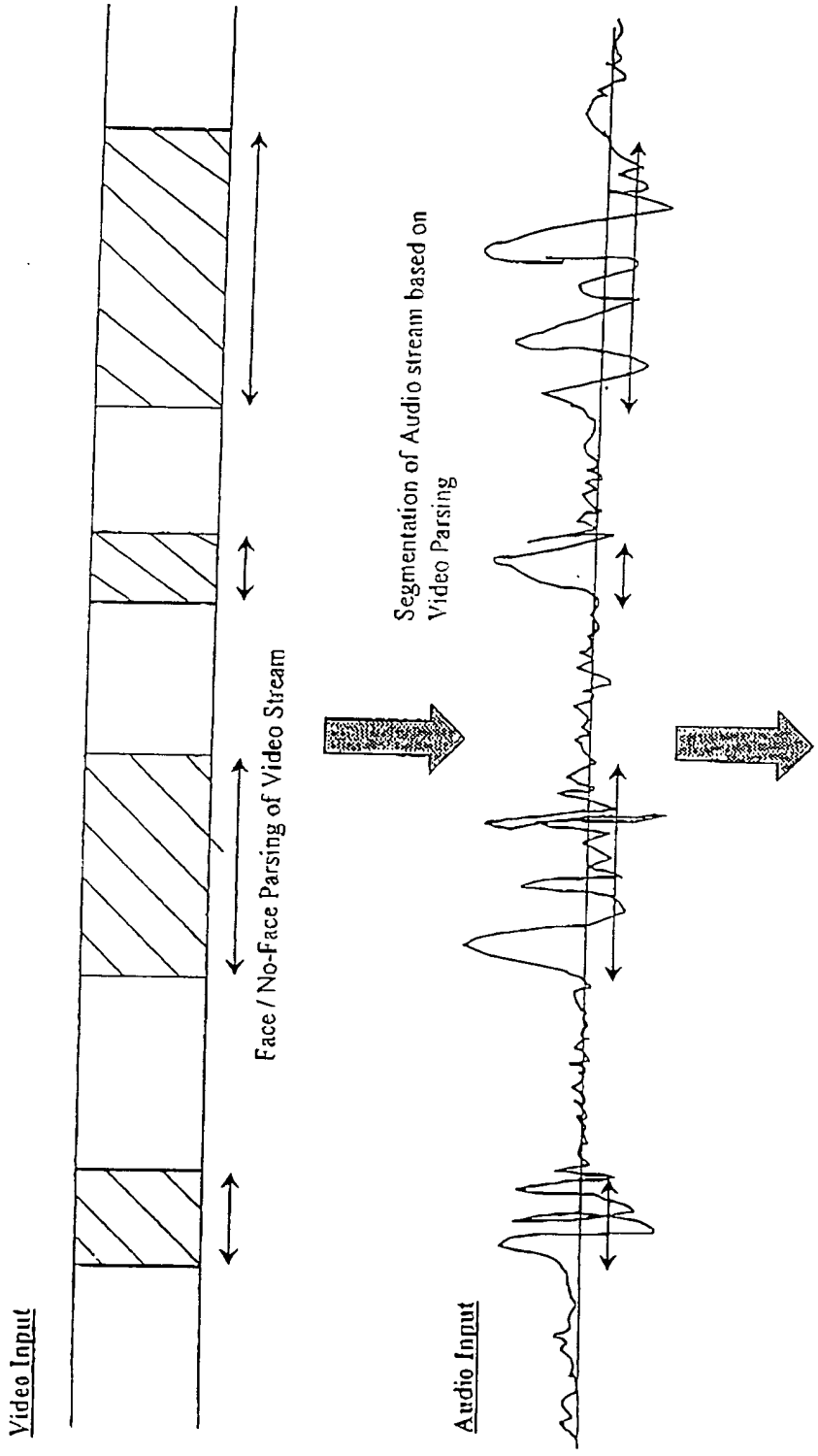

Video Input
Face / No-Face Parsing of Video Stream
Segmentation of Audio stream based on Video Parsing
Audio Input
Extraction of Audio Characteristic Data

FIG 12

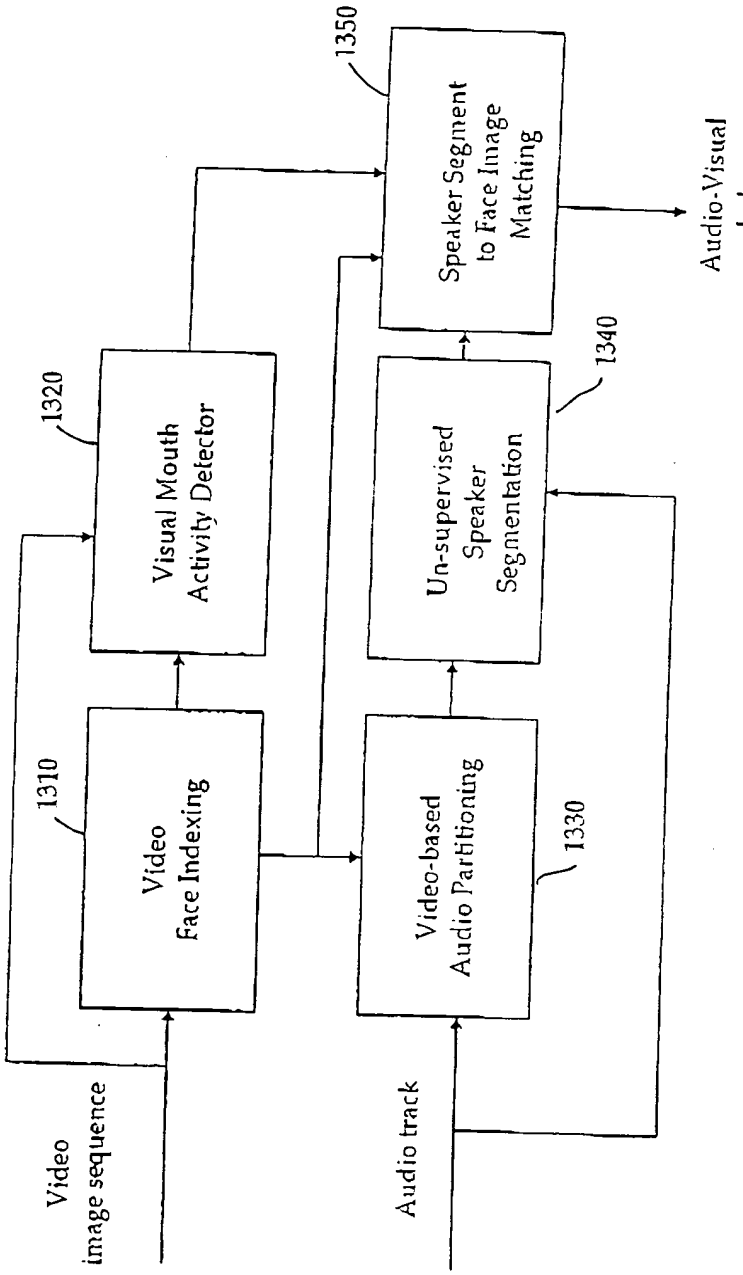

Video image sequence
Audio track
Video Face Indexing
1310
Visual Mouth Activity Detector
1320
Video-based Audio Partitioning
1330
Un-supervised Speaker Segmentation
1340
Speaker Segment to Face Image Matching
1350
Audio-Visual Index

FIG 13

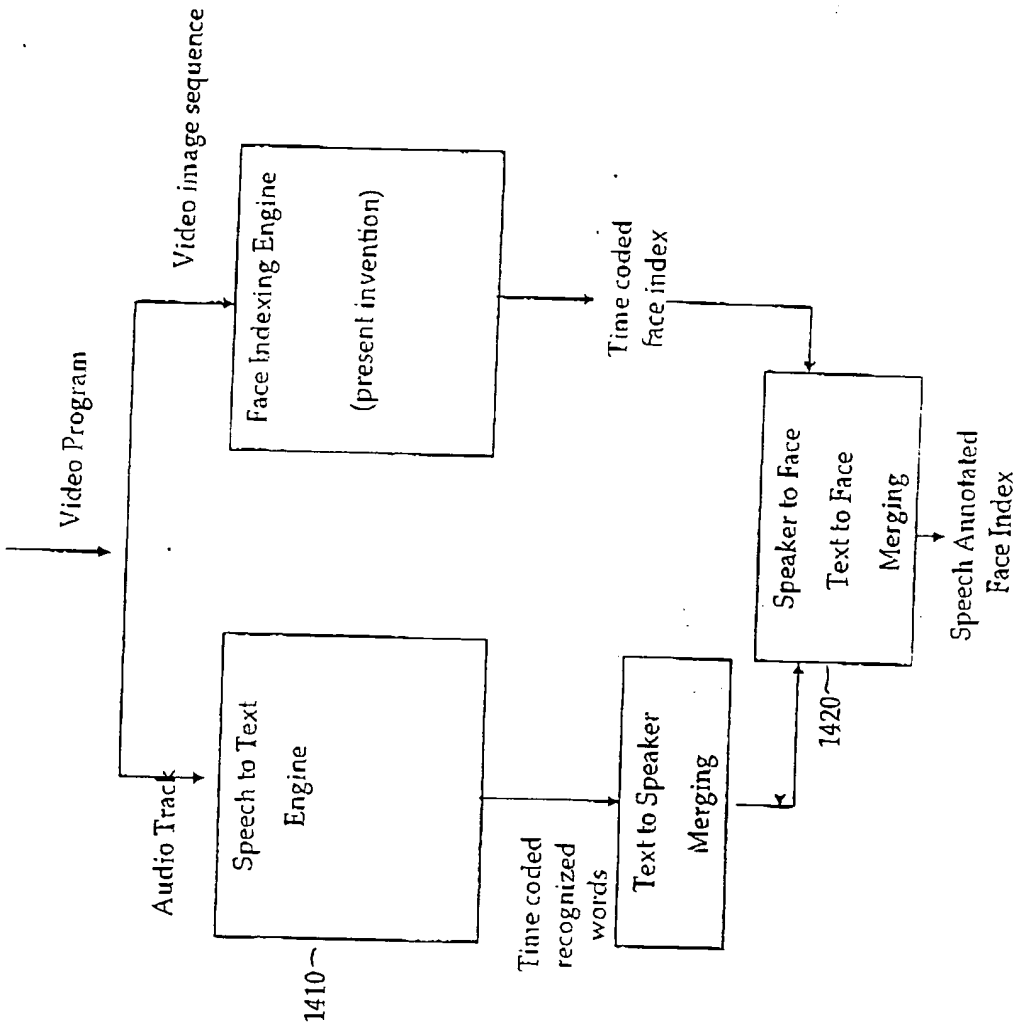

Video Program
Video image sequence
Face Indexing Engine
(present invention)
Time coded face index
Audio Track
Speech to Text Engine
1410
Time coded recognized words
Text to Speaker Merging
Speaker to Face Text to Face Merging
1420
Speech Annotated Face Index

FIG 14

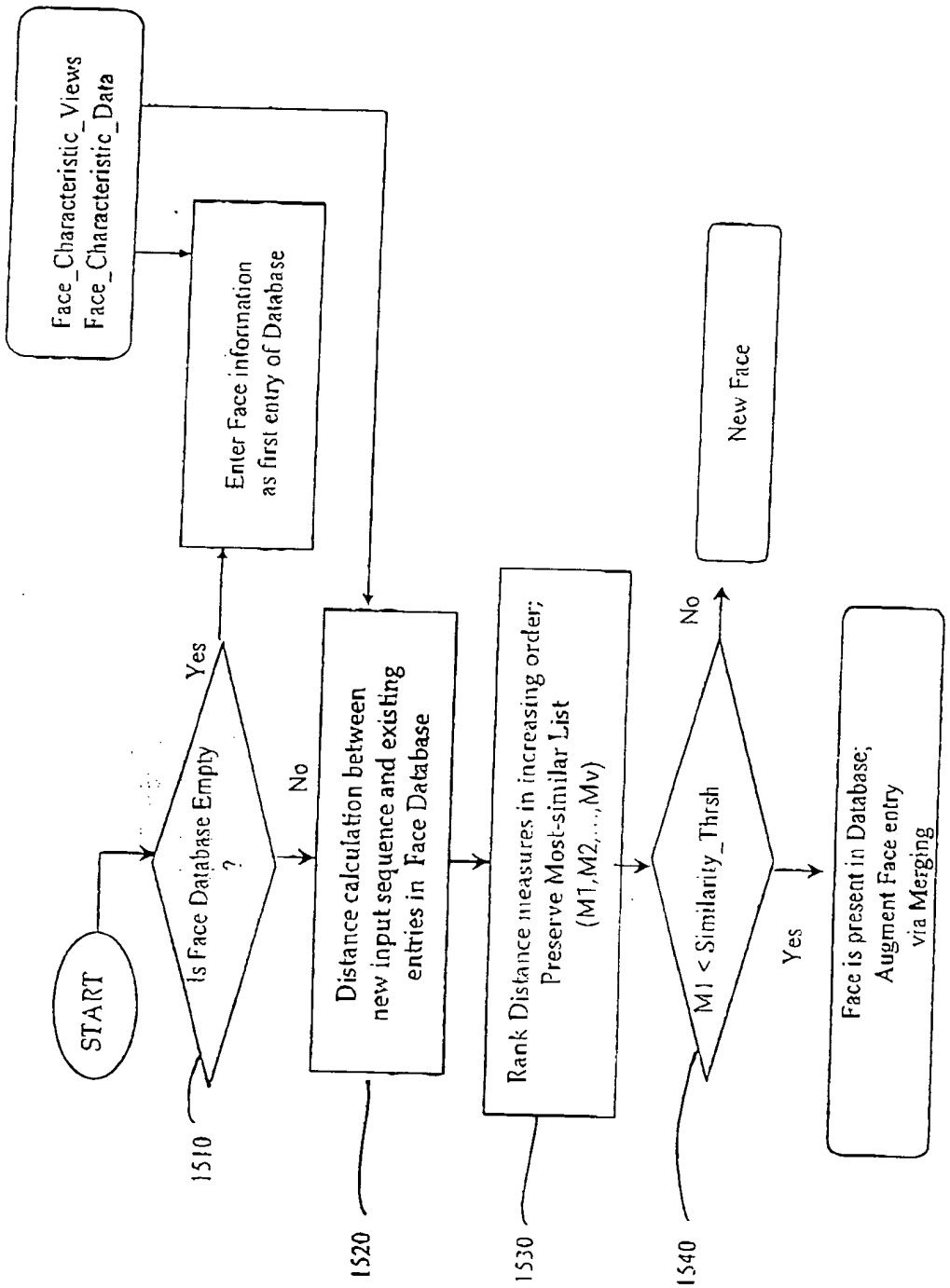

START
Is Face Database Empty ?
Yes
No
1510
Face_Characteristic_Views
Face_Characteristic_Data
Enter Face information as first entry of Database
Distance calculation between new input sequence and existing entries in Face Database
1520
Rank Distance measures in increasing order; Preserve Most-similar List (M1,M2,...,Mv)
1530
M1 < Similarity_Thrsh
No
Yes
1540
New Face
Face is present in Database; Augment Face entry via Merging

FIG 15

09786865 "062702

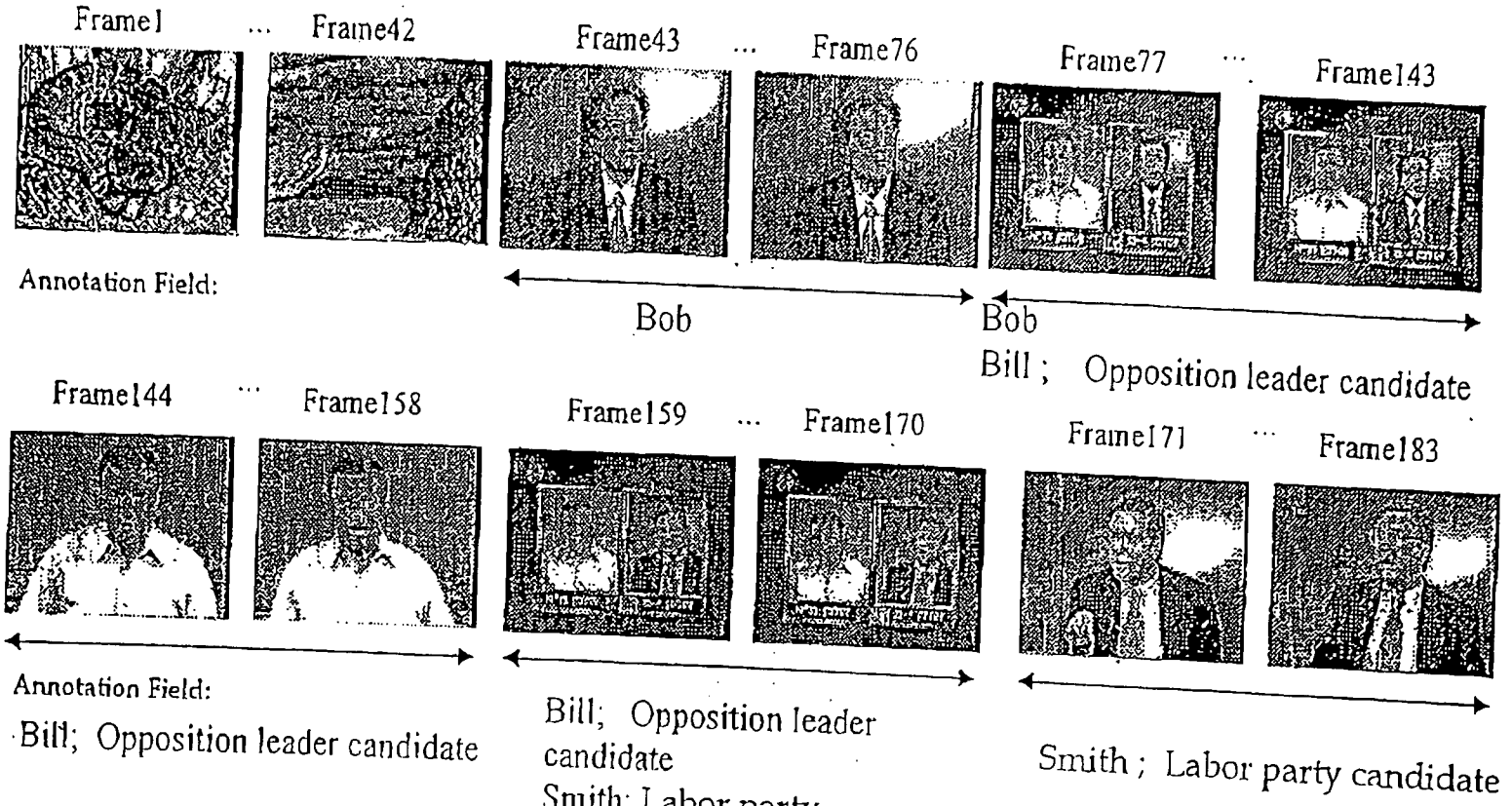


FIG 16

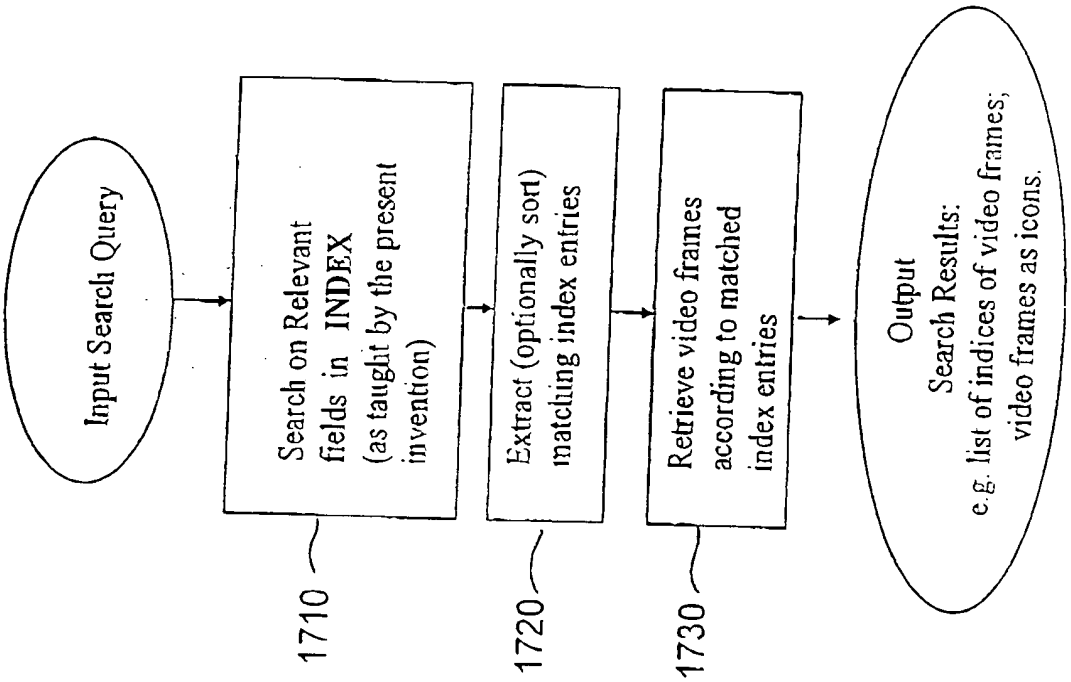

Input Search Query
Search on Relevant fields in INDEX (as taught by the present invention)
Extract (optionally sort) matching index entries
Retrieve video frames according to matched index entries
Output Search Results: e.g. list of indices of video frames; video frames as icons.
1710
1720
1730

FIG 17